# Disaster Waste and Its Management

Disaster is an event and phenomena, which left behind devastating footprints with the death and destruction of lives and properties.

The left out footprint consist of physical damages to the buildings/Infrastructure and properties inside the damaged and destroyed buildings and the daily uses utilities.

After disaster, the people and government need to put its effort to manage the disaster induced waste generated by the event.

# Disaster Waste and Its Management

- Disasters and conflicts can generate large quantities of solid and liquid waste that threaten public health, hinder reconstruction and impact the environment. Disaster Waste (DW) can be generated by the actual disaster, **as well as**, later during the response and recovery phases.
- Public health risks
  - Direct contact with waste accumulated in the streets,
  - Hazardous wastes such as asbestos, pesticides, oils and solvents,
  - Indirectly from vectors such as flies and rodents,
  - Post disaster collapse of unstable structures.

# Disaster Waste and Its Management

- Relief and reconstruction efforts can be hindered when DW blocks access to affected populations and areas.
- Environmental impacts, which are closely associated with human impacts, can include waterways, agricultural areas and communities contaminated by chemicals and heavy metals. Physical obstruction of waterways can also occur. In most cases, DW places more burdens on communities already struggling to cope with catastrophe.

# Disaster Waste and Its Management

- DW also presents opportunities: it may contain valuable material such as concrete, steel, and timber as well as organics for composting. This value can be realized as either a source of income or as a reconstruction material, and reduce burdens on natural resources that might otherwise be harvested for reconstruction.
- Safe handling, removal and management of DW are therefore important issues in disaster response and recovery.
- Effective approaches can help manage DW risks to life and health and seize opportunities from the waste to support recovery and development outcomes.

# Disaster Waste and Its Management

- Current DW management practice involves either
  - No action, in which the waste is left to accumulate and decompose,
  - Improper action, in which the waste is removed and dumped in an uncontrolled manner. Improper dumping may create long-term environmental problems that affect the community or occur on economically significant land and require the waste to be moved again, creating additional costs.
- National authorities have the primary responsibility for dealing with DW, when overwhelmed by a disaster it is unclear which international assistance agency can provide which type of assistance to them.

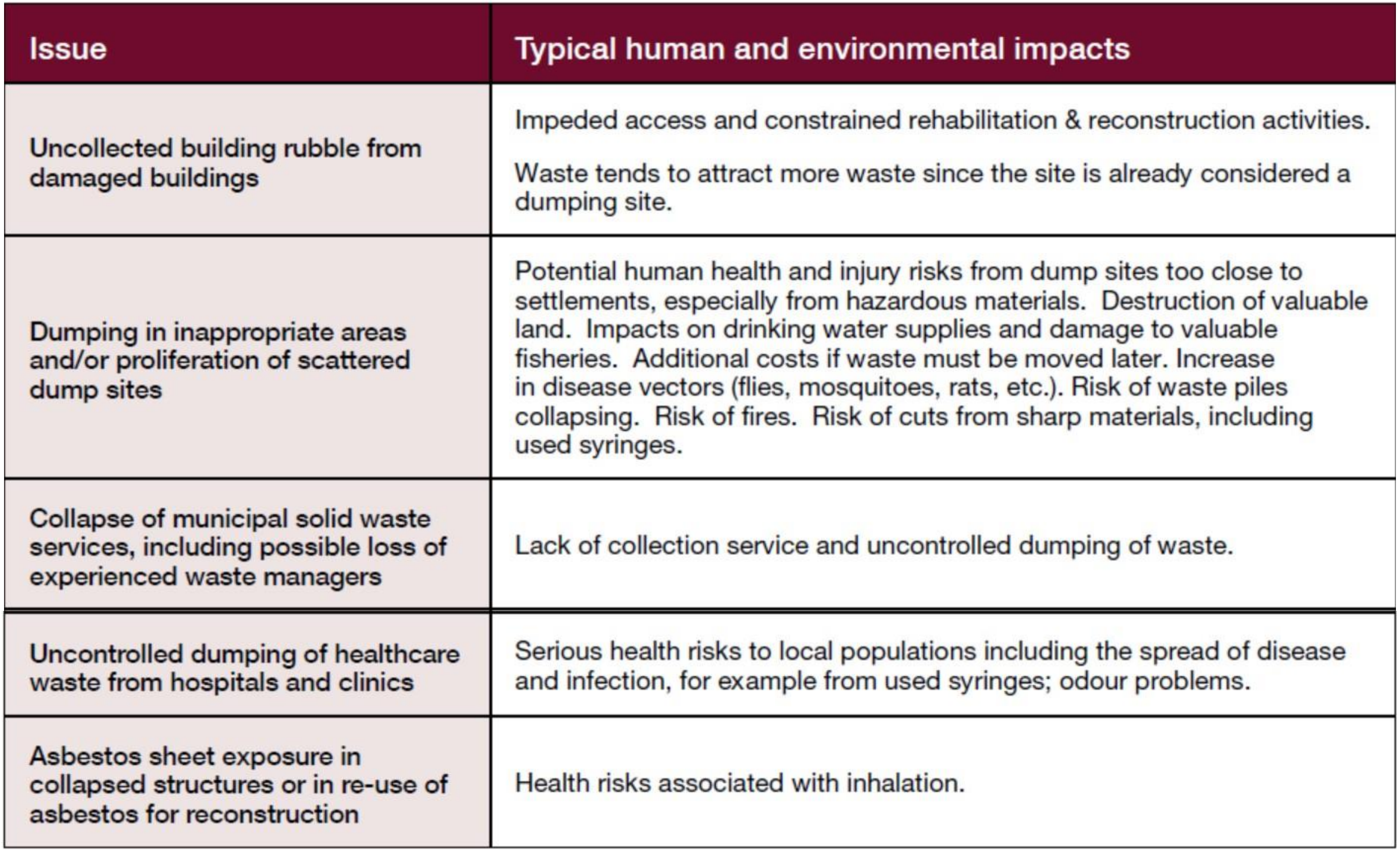
# Common examples of Disaster Waste

- Concrete, steel, wood, clay and tar elements from damaged buildings and infrastructures;
- Household furnishings; parts from the power and telephone grids such as electrical poles, wire, electronic equipment, transformers;
- Parts from water and sewage distribution systems;
- Natural debris such as clay, mud, trees, branches, bushes, palm tree leaves;
- Chemicals, dyes and other raw materials from industries and workshops;
- Waste from relief operations;
- Damaged boats, cars, buses, bicycles;
- Unexploded ordnance (e.g. landmines);
- Waste from disaster settlements and camps including food waste, packaging materials, excreta and other wastes from relief supplies;
- Pesticides and fertilizers;
- Household cleaners;
- Paint, varnish and solvents; and
- Healthcare waste.

# Disaster Waste and Its Management

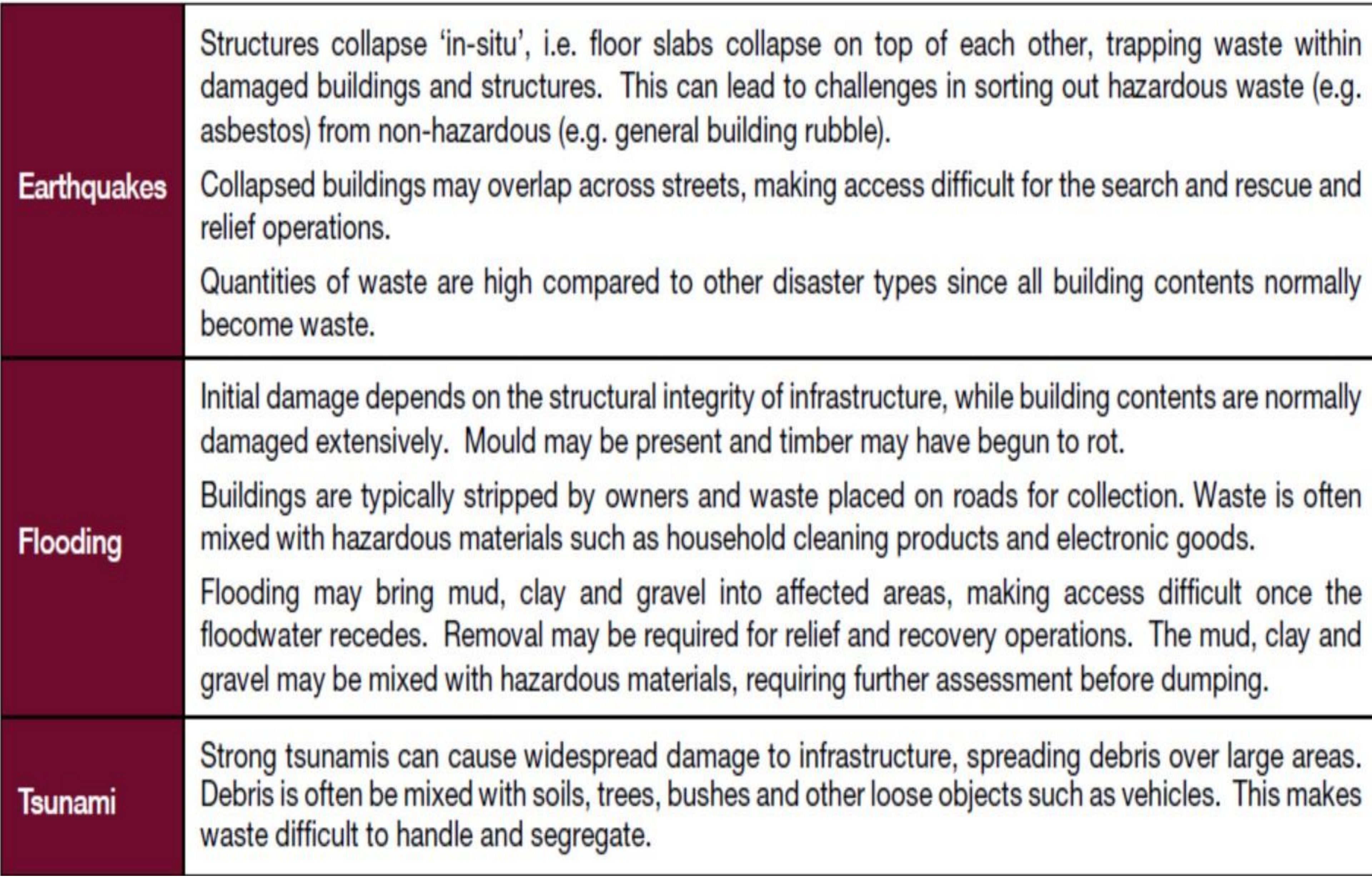
- Human corpses, animal carcasses, faecal material and urine disposed of in functioning latrines or contaminated land.

# Typical disaster waste issues and their impacts



| Issue | Typical human and environmental impacts |
|---|---|
| Uncollected building rubble from damaged buildings | Impeded access and constrained rehabilitation & reconstruction activities.<br>Waste tends to attract more waste since the site is already considered a dumping site. |
| Dumping in inappropriate areas and/or proliferation of scattered dump sites | Potential human health and injury risks from dump sites too close to settlements, especially from hazardous materials. Destruction of valuable land. Impacts on drinking water supplies and damage to valuable fisheries. Additional costs if waste must be moved later. Increase in disease vectors (flies, mosquitoes, rats, etc.). Risk of waste piles collapsing. Risk of fires. Risk of cuts from sharp materials, including used syringes. |
| Collapse of municipal solid waste services, including possible loss of experienced waste managers | Lack of collection service and uncontrolled dumping of waste. |
| Uncontrolled dumping of healthcare waste from hospitals and clinics | Serious health risks to local populations including the spread of disease and infection, for example from used syringes; odour problems. |
| Asbestos sheet exposure in collapsed structures or in re-use of asbestos for reconstruction | Health risks associated with inhalation. |

# Hazard Type and Their Waste Characteristics



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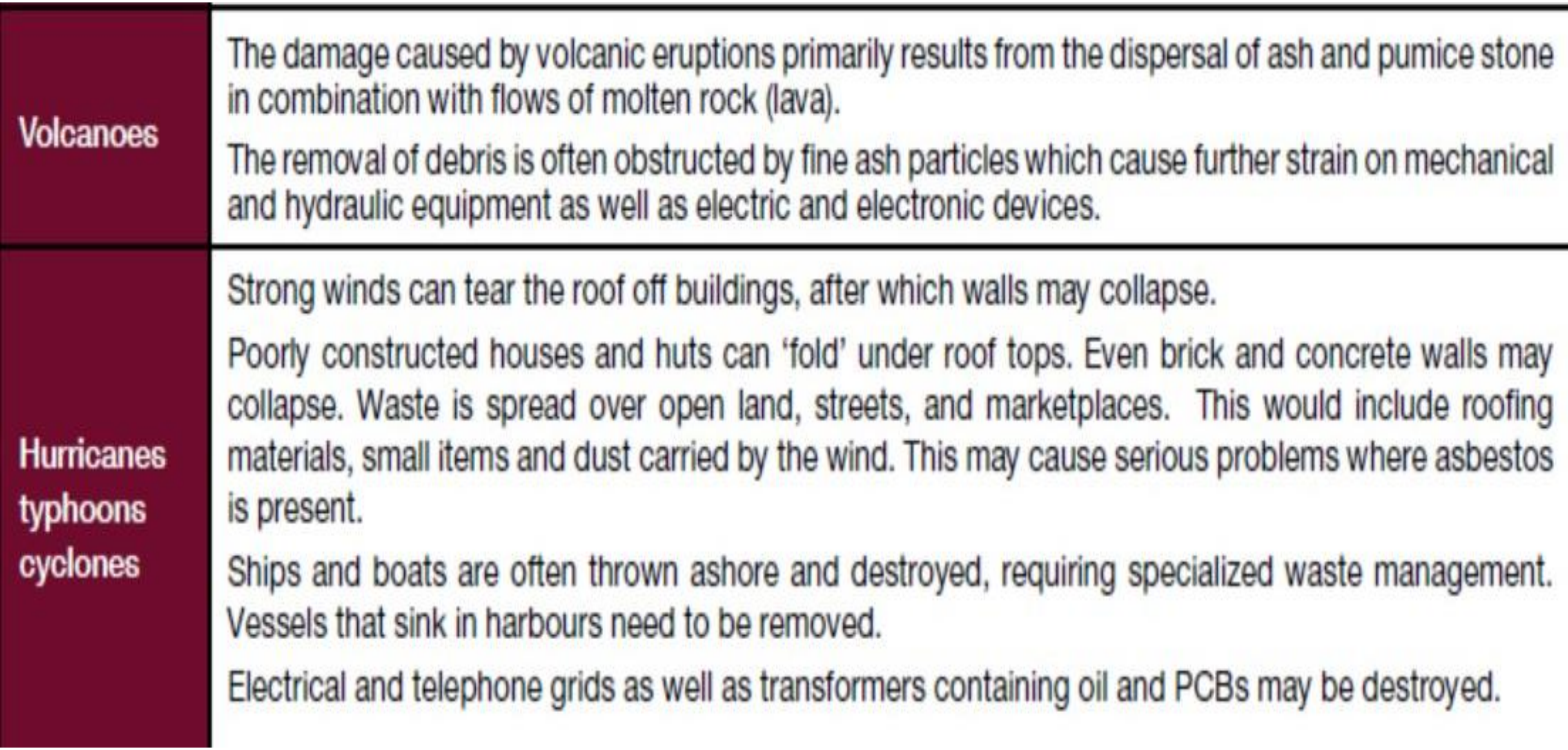
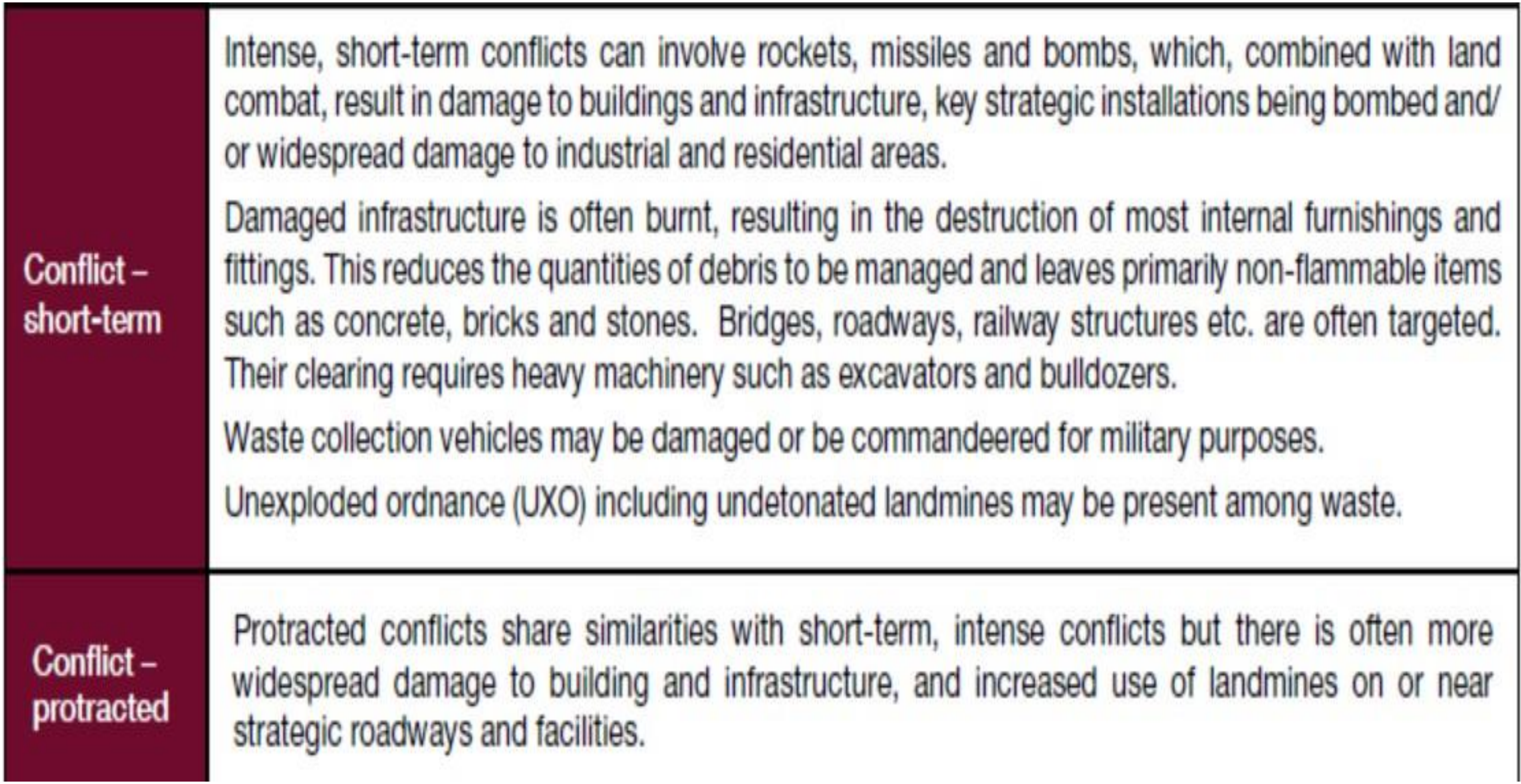
|---|---|
| **Earthquakes** | Structures collapse ‘in-situ’, i.e. floor slabs collapse on top of each other, trapping waste within damaged buildings and structures. This can lead to challenges in sorting out hazardous waste (e.g. asbestos) from non-hazardous (e.g. general building rubble).<br>Collapsed buildings may overlap across streets, making access difficult for the search and rescue and relief operations.<br>Quantities of waste are high compared to other disaster types since all building contents normally become waste. |
| **Flooding** | Initial damage depends on the structural integrity of infrastructure, while building contents are normally damaged extensively. Mould may be present and timber may have begun to rot.<br>Buildings are typically stripped by owners and waste placed on roads for collection. Waste is often mixed with hazardous materials such as household cleaning products and electronic goods.<br>Flooding may bring mud, clay and gravel into affected areas, making access difficult once the floodwater recedes. Removal may be required for relief and recovery operations. The mud, clay and gravel may be mixed with hazardous materials, requiring further assessment before dumping. |
| **Tsunami** | Strong tsunamis can cause widespread damage to infrastructure, spreading debris over large areas. Debris is often be mixed with soils, trees, bushes and other loose objects such as vehicles. This makes waste difficult to handle and segregate. |

# Hazard Type and Their Waste Characteristics



| | |
|---|---|
| **Volcanoes** | The damage caused by volcanic eruptions primarily results from the dispersal of ash and pumice stone in combination with flows of molten rock (lava).<br>The removal of debris is often obstructed by fine ash particles which cause further strain on mechanical and hydraulic equipment as well as electric and electronic devices. |
| **Hurricanes typhoons cyclones** | Strong winds can tear the roof off buildings, after which walls may collapse.<br>Poorly constructed houses and huts can 'fold' under roof tops. Even brick and concrete walls may collapse. Waste is spread over open land, streets, and marketplaces. This would include roofing materials, small items and dust carried by the wind. This may cause serious problems where asbestos is present.<br>Ships and boats are often thrown ashore and destroyed, requiring specialized waste management. Vessels that sink in harbours need to be removed.<br>Electrical and telephone grids as well as transformers containing oil and PCBs may be destroyed. |

# Hazard Type and Their Waste Characteristics



| | |
|---|---|
| **Conflict – short-term** | Intense, short-term conflicts can involve rockets, missiles and bombs, which, combined with land combat, result in damage to buildings and infrastructure, key strategic installations being bombed and/or widespread damage to industrial and residential areas.<br>Damaged infrastructure is often burnt, resulting in the destruction of most internal furnishings and fittings. This reduces the quantities of debris to be managed and leaves primarily non-flammable items such as concrete, bricks and stones. Bridges, roadways, railway structures etc. are often targeted. Their clearing requires heavy machinery such as excavators and bulldozers.<br>Waste collection vehicles may be damaged or be commandeered for military purposes.<br>Unexploded ordnance (UXO) including undetonated landmines may be present among waste. |
| **Conflict – protracted** | Protracted conflicts share similarities with short-term, intense conflicts but there is often more widespread damage to building and infrastructure, and increased use of landmines on or near strategic roadways and facilities. |

- 3 Conditions for waste to pose a risk to human health or the local
  - (1) hazardous (i.e. toxic to human health) or present a hazard;
  - (2) a route or ‘pathway’ by which the hazardous waste can
  - (3) impact a ‘receptor’, for example a person or a water source.
- Where these three elements of risk are present, the waste can have a negative impact and must be considered a potential priority.

# Response and Preparedness Actions

- **Phase 1:** Immediate and short term actions: Most acute waste issues required to save lives, alleviate suffering and facilitate rescue operations. Any other considerations at this stage are secondary.

❑ ***0-72 hours: Immediate Actions***

***Hazard Ranking:***

***Identify Waste Issues:***

*Geographic Location*

***Characterize Waste through site visit***

***Map Waste***

***Assess Waste***

***Prioritize Action:*** *Disposal Site, Access Clearance, utilization of available equipment and stakeholders, Separate storage and transport of Medical waste/health care waste to temporary special treatment or disposal sites*

# Response and Preparedness Actions

- ❑ ***72 hours onwards: Short Term Actions***

  ***Collection of HH Waste,***

  ***A rapid DW assessment, Exact data is not required, but reasonable ideas about the status of waste management, access to disposal sites, the ability of local authorities to handle the situation, and the need for any international assistance should be provided.***

- ***Other Considerations:***
  - Wastes from Internally Displaced Person (IDP) camps should be managed in coordination with general solid waste management services, and thus integrated with the local waste collection services.
  - Ownership of waste, in particular reusable waste, is an important issue to clarify to avoid later conflicts.

# Response and Preparedness Actions_Phase II

- **Phase 2: Medium Term Actions**
- Implementation of disaster waste management programme. Efforts towards building on the initial Phase 1 assessment but go into greater depth, with an emphasis on longer-term solutions.

❑ ***Assessments***

- Continue to assess the disaster waste (extent of waste generation, locations, types of waste, regulatory understanding, etc.).
- Assess locations for medium term temporary disposal and waste separation sites for unsorted rubble and municipal waste. This may entail upgrading or improving current dumpsites.
- Assess requirements to close current dumpsites if these pose a threat to human health or the environment.
- Identify and assess other waste management facilities in or near to the disaster affected area.
- Assess local capacities for addressing disaster waste and identify gaps/needs for additional assistance.

# Response and Preparedness Actions_Phase II

❑ ***Operations***

- Establish temporary storage sites for debris and regular waste.
- Initiate collection and transportation of waste and debris, with the goal of expanding this in the latter phases .
- Prepare practical advice and guidance for local authorities on interim solutions to minimize environmental and health impacts of disaster waste.

# Response and Preparedness Actions_Phase II

❑ ***Planning***

- Implement a communications plan for affected communities with a focus on opportunities (i.e. reuse and recycling), risks (i.e. human health risks) and collection schemes.
- Develop a plan for healthcare waste. This may entail the construction of a temporary incinerator for healthcare waste.
- Develop a special plan for hazardous waste (including asbestos) collection and treatment.
- Consult affected communities on issues relating to public health, wastes, livelihoods and the environment.
- Identify exit strategies and handover options for the disaster waste management systems planned for establishment.

# Response and Preparedness Actions_Phase II

☐ ***Communication and Reporting***

- Communicate rapidly and regularly regarding all findings to the local authorities
- Document in electronic form the assessment results, recommendations, and mitigation measures implemented.

The outputs from these planning actions include data and information to design a disaster waste management programme to be implemented in the recovery phase.

# Response and Preparedness Actions_Phase III

## ❑ Phase 3: Long Term Actions

- This Phase includes implementation of disaster waste management projects designed in Phase 2, and continued monitoring and evaluation of the disaster waste situation.
  - Develop and implement a communications plan
  - Procure or repair required waste management plant, machinery and equipment.
  - Train waste management operators if required.
  - Support the implementation of disaster waste management systems by supporting waste management operators/operatives or local authorities.
  - Hand over disaster waste management systems into a normalized and improved solid waste management system.
- The output of this phase should be having all disaster waste addressed either through disposal, incineration, reuse or recycling.

# Response and Preparedness Actions_Contingency Planning

## ❑ Phase 4: Contingency Planning

- It is not part of emergency response. However, it does help bridge the gap between response, recovery, and longer-term development and is therefore an important investment.
- Contingency planning can be conducted during the long term phase or as a preparedness measure prior to disaster.
- The objective is to develop a Disaster Waste Management Contingency Plan (DWMCP) to aid communities in determining appropriate management options in advance of a disaster.
- A plan identifying cost-effective disaster waste management options and resources can save money, increase control over waste management and improve administrative efficiency.
- The plan may also serve as a resource document in negotiating technical and financial assistance.

# Response and Preparedness Actions_Contingency Planning

An effective DWMCP addresses issues well beyond initial removal and should include a strategy for recycling and reuse of materials (including composting). There are many possible components of a DWMCP, including:

1. Pre-planning activities;
2. Secondary activities

- **Establish governmental coordination.**
- **Identify likely waste and debris types.**
- **Forecast amounts of waste and debris.**
- **List applicable national, and local environmental regulations.**
- **Inventory current capacity for waste and debris management and determine waste and debris tracking mechanisms.**
- **Pre-select temporary waste and debris storage sites and identify opportunities for secure temporary storage of hazardous waste.**

- **Identify equipment and administrative needs.**
- **Pre-negotiate contracts.**
- **Develop a communications plan.**
- **Create a disaster debris prevention strategy.**
- **Create a debris removal strategy.**

# Response and Preparedness Actions_Contingency Planning

3. Harmful materials identification and hazardous waste management recommendations
4. Recycling options
5. Waste-to-energy options
6. Disposal options
7. Open burning options

# Case Study

- Nepal is enlisted as one of the disaster prone country in the World. It ranks 4th, 11th and 30th in terms of climate change, earthquake and flood risk.
- Landslide, fire, drought, epidemic, storm, hailstorm, avalanches and Glaciers Lake Out-burst Flood (GLOF).
- A devastating earthquake measuring in 7.8 Richter scale hit Nepal on 25 April 2015 at 11:56 AM (Local Time). Its epicenter was in Barpak, Gorkha some 77 kilometers northwest from the Kathmandu . The earthquake was preceded by a major aftershock of 7.3 magnitude on 12th May 2015.
- The earthquake in 2015 killed nearly 9000 people, injured 30,000 and destroyed 800000 buildings.
- Statistics of Nepal police up to 22nd June 2015 shows the data that 8660 people had lost their lives and 21,952 were injured .
- 7,532 schools and 1,100 health services were also damaged.

- There was huge amount of debris accumulated in earthquake affected 31 districts.

- Based on the construction practices and materials used, debris from destroyed or damaged building by a major earthquake would consists mainly of brick, stone, concrete blocks, tiles, cement concrete, steel bars, CGI sheets, wooden joist, beams, doors and window frames, steel pipes and tanks, UPVC pipes and tanks, electrical wires and cables, broken glass pieces and furniture and fixture
- Solid waste management technical support center had conducted assessment and research on volume of disaster waste, type, and characteristic of disaster waste.
- Nearly 14 million tons of waste was generated within a couple of day, four million tons of waste alone from Kathmandu, which is equal to waste generation in 11 year in normal time (PDNA 2015). This large amount of disaster related waste mixed with hazardous wastes was observed exposed to various infections, resulting in adverse impact to human health and environment (REA, MoEST, 2015).

- Disaster waste generated during 2015 Earthquake is still deposited randomly on roadsides and public places around the public places and private lands in the 14 earthquake affected districts.

# Case Study

- According to PDNA, the waste produced from temporary shelters and the debris generated from destructed houses in 14 affected districts were not in priority of any Local governmental bodies for management despite of identifying the temporary disposal sites.
- Thus, it can be clearly envisioned that disaster waste management practice in Nepal is lagging behind, as off not having appropriate policies to mobilize the skilled manpower, equipment, institutional mechanism, and financial support pre and post disaster.

# Case Study

- Disaster Risk Reduction and Management Act 2017 is the one in which disaster waste is mentioned “removal of disaster generated waste” in the Clause#2 under the district disaster management committee’s roles and responsibilities.
- Similarly under the clause #20 under public and private commercial establishment roles and responsibility it was mentioned “ appropriate management of waste and pollution to minimize adverse impact to people”. This clause will greatly help in management of waste generated from the industrial and commercial establishment in the post disaster situation.
- There has also been absence of knowledge about the disaster waste management, which ,needs to be addressed in the legal framework of Nepal.